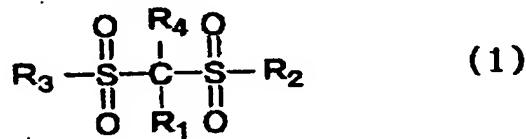


## CLAIMS

1. A secondary battery comprising:
  - a positive electrode;
  - a negative electrode; and
- 5 an electrolyte solution comprising an aprotic solvent having at least an electrolyte dissolved therein,

wherein the positive electrode comprises a lithium-manganese composite oxide having a spinel structure as a positive electrode active material, and
- 10 the electrolyte solution comprises a compound represented by the general formula (1):

[Formula 1]



wherein  $\text{R}_1$  and  $\text{R}_4$  independently represent an atom or a group selected from a hydrogen atom, a substituted or unsubstituted alkyl group having 1 to 5 carbon atoms, a substituted or unsubstituted alkoxy group having 1 to 5 carbon atoms, a substituted or unsubstituted fluoroalkyl group having 1 to 5 carbon atoms, a polyfluoroalkyl group having 1 to 5 carbon atoms,  $-\text{SO}_2\text{X}_1$ , wherein  $\text{X}_1$  is a substituted or unsubstituted alkyl group having 1 to 5 carbon atoms,  $-\text{SY}_1$ , wherein  $\text{Y}_1$  is a substituted or unsubstituted alkyl group having 1 to 5 carbon atoms,  $-\text{COZ}$ , wherein  $\text{Z}$  is a hydrogen atom or a substituted or unsubstituted alkyl group having 1 to 5 carbon atoms, and a halogen atom; and  $\text{R}_2$  and  $\text{R}_3$  independently represent

an atom or a group selected from a substituted or unsubstituted alkyl group having 1 to 5 carbon atoms, a substituted or unsubstituted alkoxy group having 1 to 5 carbon atoms, a substituted or unsubstituted phenoxy group, a substituted or unsubstituted fluoroalkyl group having 1 to 5 carbon atoms, a

5 polyfluoroalkyl group having 1 to 5 carbon atoms, a substituted or unsubstituted fluoroalkoxy group having 1 to 5 carbon atoms, a polyfluoroalkoxy group having 1 to 5 carbon atoms, a hydroxyl group, a halogen atom,  $-NX_2X_3$ , wherein  $X_2$  and  $X_3$  independently represent a hydrogen atom or a substituted or unsubstituted alkyl group having 1 to 5

10 carbon atoms, and  $-NY_2CONY_3Y_4$ , wherein  $Y_2$  to  $Y_4$  independently represent a hydrogen atom or a substituted or unsubstituted alkyl group having 1 to 5 carbon atoms.

2. The secondary battery according to claim 1, wherein the lithium-manganese composite oxide having a spinel structure is  $Li(M_xMn_{1-x})_2(O_{1-y}F_y)_4$  ( $0 \leq x \leq 0.118$  and  $0 \leq y \leq 0.1$ ), wherein M is at least one element selected from the group consisting of Li, B, Na, Mg, Al, Si, S, K, Ca, Sc, Ti, V, Cr, Fe, Co, Ni, Cu, Zn, Ga, Sr, Y, Zr, Nb, In, Sn, Ba, La, Ce, Nd, Sm, Ta and Pb.

20 3. The secondary battery according to claim 1 or 2, wherein the electrolyte solution has a composition that can produce hydrogen ions by reacting with water, and a hydrogen ion scavenger is placed at a location in contact with the electrolyte solution in the secondary battery.

4. The secondary battery according to claim 3, wherein the hydrogen ion scavenger is a lithium-nickel composite oxide having a hydrogen ion scavenging function, and is mixed with the positive electrode.

5 5. The secondary battery according to claim 4, wherein the lithium-nickel composite oxide having a hydrogen ion scavenging function has a specific surface area  $X_a$  ( $m^2/g$ ) of  $0.1 \leq X_a \leq 3.0$ .

6. The secondary battery according to claim 4 or 5, wherein the lithium-  
10 nickel composite oxide having a hydrogen ion scavenging function has a  $D_{50}$  particle diameter of  $1 \mu m$  to  $40 \mu m$ .

7. The secondary battery according to any of claims 4 to 6, wherein a is  $3 < a \leq 45$  when a weight ratio of the lithium-manganese composite oxide having a spinel structure to the lithium-nickel composite oxide is represented by  $[\text{lithium-manganese composite oxide having a spinel structure}] : [\text{lithium-nickel composite oxide}] = (100-a) : a$ .

8. The secondary battery according to any of claims 1 to 7, wherein the positive electrode is further mixed with  $\text{Li}(\text{Ni}_b\text{Co}_c\text{Mn}_{1-b-c})\text{O}_2$ , wherein b is  $0 \leq b \leq 2/3$  and c is  $0 \leq c \leq 2/3$ , provided that  $b + c \leq 2/3$ .

9. The secondary battery according to claim 8, wherein d is  $3 < d \leq 45$  when a weight ratio of the lithium-manganese composite oxide having a spinel structure to the  $\text{Li}(\text{Ni}_b\text{Co}_c\text{Mn}_{1-b-c})\text{O}_2$  is represented by  $[\text{lithium-}$

manganese composite oxide having a spinel structure] : [Li(Ni<sub>b</sub>Co<sub>c</sub>Mn<sub>1-b-c</sub>)O<sub>2</sub>]

= (100-d) : d.

10. The secondary battery according to any of claims 1 to 9, wherein

5 there is a bismuth compound on or near the surface of the lithium-manganese composite oxide having a spinel structure.

11. The secondary battery according to claim 10, wherein the bismuth

compound is a bismuth oxide or a composite oxide of bismuth and

10 manganese.

12. The secondary battery according to any of claims 1 to 11, wherein the

compound represented by the general formula (1) is contained in the

electrolyte solution in an amount of 0.1 to 5.0% by weight based on the total

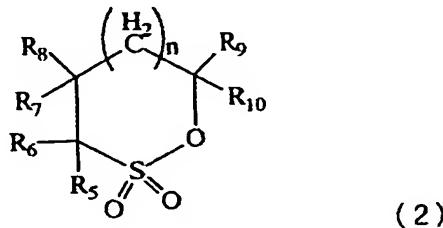
15 weight of the electrolyte solution.

13. The secondary battery according to any of claims 1 to 12, wherein the

electrolyte solution further comprises a cyclic monosulfonate represented by

the general formula (2):

20 [Formula 2]

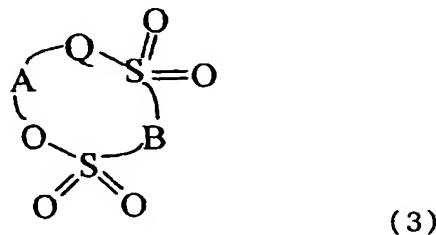


(2)

wherein n is an integer of 0 to 2; R<sub>5</sub> to R<sub>10</sub> independently represent an atom or a group selected from a hydrogen atom, a substituted or unsubstituted alkyl group having 1 to 12 carbon atoms, a substituted or unsubstituted fluoroalkyl group having 1 to 6 carbon atoms, and a 5 polyfluoroalkyl group having 1 to 6 carbon atoms.

14. The secondary battery according any of claims 1 to 13, wherein the electrolyte solution further comprises a cyclic sulfonate having two sulfonyl groups represented by the general formula (3):

10 [Formula 3]



wherein Q represents an oxygen atom, a methylene group or a single bond, and A represents a group selected from a substituted or unsubstituted alkylene group having 1 to 5 carbon atoms, a carbonyl group, a sulfinyl group, a polyfluoroalkylene group having 1 to 5 carbon atoms, a substituted or unsubstituted fluoroalkylene group having 1 to 5 carbon atoms, a substituted or unsubstituted alkylene group having 1 to 5 carbon atoms in which at least one C-C bond is replaced by a C-O-C bond, a 15 polyfluoroalkylene group having 1 to 5 carbon atoms in which at least one C-C bond is replaced by a C-O-C bond, and B represents a group selected from 20 a substituted or unsubstituted fluoroalkylene group having 1 to 5 carbon atoms in which at least one C-C bond is replaced by a C-O-C bond; and B represents a group selected from

a substituted or unsubstituted alkylene group having 1 to 5 carbon atoms, a polyfluoroalkylene group having 1 to 5 carbon atoms, and a substituted or unsubstituted fluoroalkylene group having 1 to 5 carbon atoms.

5 15. The secondary battery according to any of claims 1 to 14, wherein the electrolyte solution further comprises at least one of vinylene carbonates and derivatives thereof.

10 16. The secondary battery according to any of claims 1 to 15, wherein the electrolyte comprises a lithium salt.

15 17. The secondary battery according to claim 16, wherein the lithium salt is at least one lithium salt selected from the group consisting of  $\text{LiPF}_6$ ,  $\text{LiBF}_4$ ,  $\text{LiAsF}_6$ ,  $\text{LiSbF}_6$ ,  $\text{LiClO}_4$ ,  $\text{LiAlCl}_4$  and  $\text{LiN}(\text{C}_k\text{F}_{2k+1}\text{SO}_2)(\text{C}_m\text{F}_{2m+1}\text{SO}_2)$ , wherein k and m are independently 1 or 2.

20 18. The secondary battery according to any of claims 1 to 17, wherein the aprotic solvent is at least one organic solvent selected from the group consisting of cyclic carbonates, chain carbonates, aliphatic carboxylates,  $\gamma$ -lactones, cyclic ethers, chain ethers and fluorinated derivatives thereof.

19. The secondary battery according to any of claims 1 to 18, wherein the secondary battery is covered with a laminated exterior package.